APPARATUS DESIGNED TO EVALUATE THE NEGATIVE PHOTOTACTIC BEHAVIOR OF FIRST INSTAR *AEDES AEGYPTI*

D. E. SIMONET AND E. C. TURNER, JR.

Department of Entomology, VPI & SU, Blacksburg, VA 24061

ABSTRACT. A 4-chambered photomigration apparatus was developed to evaluate the phototactic behavior of 1st instar *Aedes aegypti* larvae. The number of larvae migrating 20 cm from a 15-watt fluorescent light in 60 sec was measured. First instar *A. aegypti* larvae exhibited a consistent and reproducible negative response to light under controlled conditions.

Measurement of the phototactic response of *Aedes aegypti* (L.) larvae has been useful in toxicological studies of insecticides for many years (Burchfield et al. 1953, Burchfield and Hartzell 1955, Hassett et al. 1960, Das and Needham 1961). The apparatus used in the above studies has basically consisted of a single chamber unit designed to measure this response after exposure of 3rd or 4th instar larvae to various insecticide concentrations, thus providing a rapid and efficient interpretation of insecticide toxicity to the larvae.

We felt that a simple, quick, and efficient toxicity test could be developed by using the response of 1st instar larvae to light. The rapid rate of hatching of *A. aegypti* eggs when placed in water allows a uniformly aged test population to be readily available, and thus a standard rearing procedure for the test organism is unnecessary. However, the phototactic response of 1st instar larvae has not been thoroughly studied. Burchfield et al. (1952) found that 1st instar larvae did not migrate satisfactorily in their apparatus. Omardeen (1957) believed that 1st instar *A. aegypti* larvae were too small to study light response in his apparatus.

The first task in developing a test using

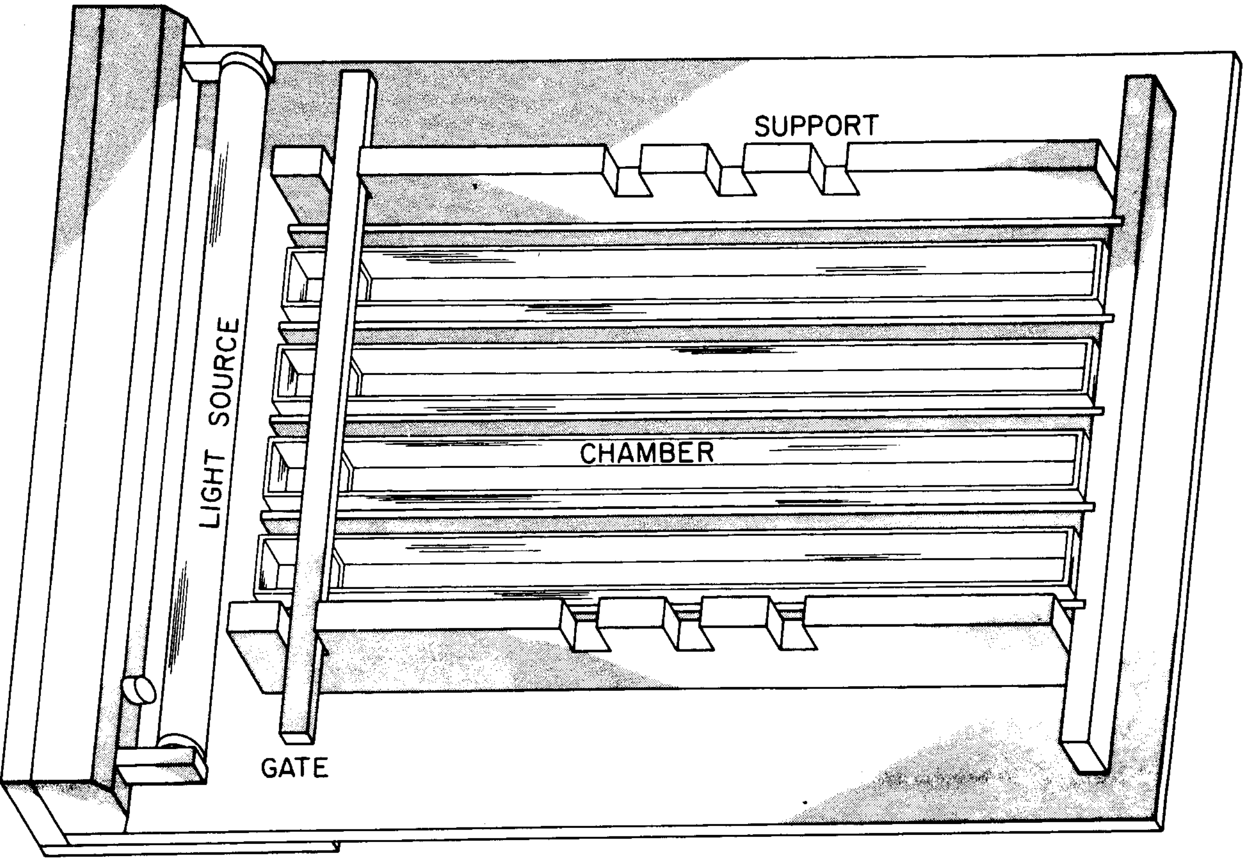

Fig. 1. Multiunit photomigration apparatus used to measure photomigration rate of first instar *A. aegypti* larvae.

1st instar *A. aegypti* larvae was to design an apparatus which would effectively measure the photomigration rate of the larvae under controlled conditions. A multiunit testing apparatus consisting of 4 glass chambers (4 x 4 x 47 cm long) constructed from single thickness glass was developed (Fig. 1). Plexiglass® strips painted flat black were placed between the chambers to minimize reflection. A 15-watt fluorescent tube (Sylvania F15T8CW) was placed 2 cm from one end of the chambers to serve as the light source. Another plexiglass strip (not shown in Fig. 1) painted flat black was used as a light shield by placing it between the light source and glass chambers.

The gates used to confine larval movement in the glass chambers consisted of four plexiglass tabs, one of which fitted into each chamber. Each tab supported a stainless steel screen (100 mesh) bordered by a seal made of 30 gauge rubber sheeting (Davol Inc., Providence, R. I. 02901) (Fig. 2). By attaching the 4 tabs to a single grooved wooden strip, the gates could be raised and lowered simultaneously. Two pieces of wood with grooves at 2, 20, 25, and 30 cm from the lighted end of the chambers were used to support the gate, and to insure accuracy in placing the gate at a constant position between replications.

Larvae used in the tests were obtained from eggs in a stock colony maintained at this laboratory according to guidelines established by Peters et al. (1969). Eggs were vacuum hatched (Barbosa and Peters 1969) and resulting larvae were placed in stacking dishes (155 x 55 mm) containing 100 ml of an artificial hard water, developed by Cairns (1969), at a rate of 50 larvae per dish.

After a 2 hr acclimation period, basic migration studies were conducted on the larvae by placing 50 larvae in each of the chambers containing 200 ml of Cairns' hard water. Larvae were confined in the 2 cm area behind the gate. The fluorescent light was turned on and tests were initiated by simultaneously lifting the gate and light shield. Tests were ended after allowing a 60 sec migration period by placing the gate at the 20 cm distance. The number of larvae beyond the 20 cm point was recorded. Temperature readings of the water in the chambers were taken before and after tests to insure that a standard temperature of 27 ± 1°C was maintained.

The mean and standard error for 13 replications of each chamber (44.0 ± 0.89, 43.3 ± 0.79, 43.9 ± 0.92, and 43.0 ± 0.92 respectively) indicated that the larvae exhibited a low level of variability in phototactic response when tested in the photomigration chambers. A single classification analysis of variance showed no significant difference between the 4 chambers ($P=0.75$). The low variability between chambers would be important for toxicity tests since one chamber would always be used

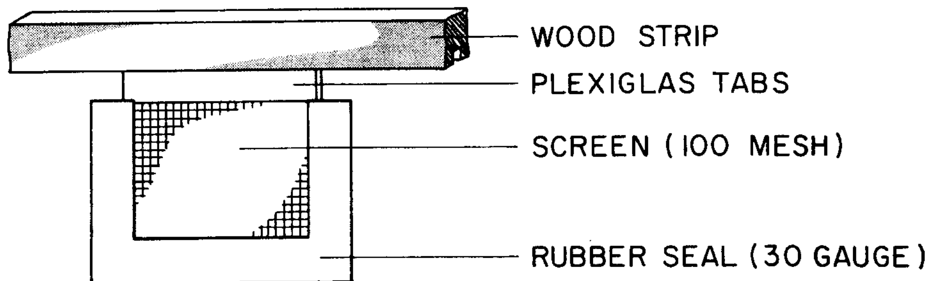

Fig. 2. Gate mechanism used to confine first instar *A. aegypti* larvae when tested in the multiunit photomigration apparatus.

as a control when evaluating the effect of the toxicant on photomigration.

The multiunit chamber design allows a high degree of accuracy in measuring the negative phototactic response of 1st instar *A. aegypti*. This study has shown that 1st instar larval response to light is consistent and reproducible under controlled conditions. In addition to their consistent negative phototaxis, the 1st instar larvae are easily obtained from eggs, uniform in development, and do not require a standard rearing procedure. These factors make them desirable for use in laboratory toxicity tests.

ACKNOWLEDGMENTS. The authors would like to express their appreciation to Drs. J. L. Eaton and R.L Pienkowski for their critical review of the manuscript, and to thank Mr. F. B. Rock for his technical assistance in constructing the photomigration apparatus. This study was supported in part by the Virginia Office of Water Resources Research Center, Project A-042-VA.

References Cited

Barbosa, P. and T. M. Peters. 1969. A comparative study of egg hatching techniques for *Aedes aegypti* (L.). Mosquito News. 29(4): 548-51.

Burchfield, H. P. and A. Hartzell. 1955. A new bioassay method for evaluation of insecticide residues. J. Econ. Entomol. 48(2):210-14.

Burchfield, H. P., J. D. Hilchey and E. E. Storrs. 1952. An objective method for insecticide bioassay based on photomigration of mosquito larvae. Contrib. Boyce Thompson Inst. 17:57-86.

Cairns, J., Jr. 1969. Fish bioassays—reproducibility and rating. Revista de Biologia. 7(1-2): 7-12.

Das, M. and P. H. Needham. 1961. Effect of time and temperature on toxicity of insecticides to insects. I. Tests of DDT on larvae of *Aedes aegypti* (L.). Ann. Appl. Biol. 49(1):32-8.

Hassett, C. C., R. Kirk and G. B. Craig. 1960. Apparatus for insecticide assay. J. Econ. Entomol. 53(3):483.

Omardeen, T. A. 1957. The behavior of larvae and pupae of *Aedes aegypti* (L.) in light and temperature gradients. Bull. Entomol. Res. 48 (2):349-57.

Peters, T. M., B. I. Chevone, N. C. Greenough, R. A. Callahan and P. Barbosa. 1969. Intraspecific competition in *Aedes aegypti* (L.): I. Equipment, techniques, and methodology. Mosquito News. 29(4):667-74.